Fate of Mercury in Synthetic Gypsum Used for Wallboard Production

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Abstract

This report presents and discusses results from the study "Fate of Mercury in Synthetic Gypsum Used for Wallboard Production," performed at a full-scale commercial wallboard plant. Synthetic gypsum produced by wet flue gas desulfurization (FGD) systems on coal-fired power plants is commonly used in the manufacture of wallboard. The FGD process is used to control the sulfur dioxide emissions which would result in acid rain if not controlled. This practice has long benefited the environment by recycling the FGD gypsum byproduct, which is becoming available in increasing quantities, decreasing the need to landfill this material, and increasing the sustainable design of the wallboard product. However, new concerns have arisen as recent mercury control strategies developed for power plants involve the capture of mercury in FGD systems. The objective of this study is to determine whether any mercury is released into the atmosphere when the synthetic gypsum material is used as a feedstock for wallboard production. The project is being co-funded by the U.S. DOE National Energy Technology Laboratory (Cooperative Agreement DE-FC26-04NT42080), USG Corporation, and EPRI. USG Corporation is the prime contractor, and URS Group is a subcontractor.

The project scope includes six discrete tasks, each conducted at various USG wallboard plants using synthetic gypsum from different FGD systems. The original five tasks were to include 1) a baseline test, then variations representing differing power plant 2) emissions control configurations, 3) treatment of fine gypsum particles, 4) coal types, and 5) FGD reagent types. However, Task 5, which was to evaluate gypsum produced from an alternate FGD reagent, could not be conducted as planned. Instead, Task 5 was conducted at conditions similar to a previous task, Task 3, although with gypsum from an alternate FGD system. An additional Task 6 was added in order to evaluate the effect of an additive, TMT-15 injected directly into the wet FGD system which is expected to precipitate water-soluble oxidized mercury (Hg^{+2}). The Hg-TMT precipitant formed will be mostly separated from the gypsum product used in wallboard manufacture and any remaining precipitant is predicted to be thermally stable beyond temperatures encountered during wallboard manufacture. Thus the use of the additive is expected to greatly reduce mercury emissions lost during wallboard manufacture. During this

additional task, the same FGD will be evaluated as in Task 5, however the TMT-15 will be added into the FGD system when the FGD material is created. This provides us with the unique opportunity to compare mercury emissions during wallboard manufacture using FGD gypsum from a single source with and without the use of the TMT-15 additive.

In this project, process stacks in the wallboard plant have been sampled using the Ontario Hydro method. The stack locations sampled for each task include a dryer for the wet gypsum as it enters the plant and a gypsum calciner. The stack of the dryer for the wet wallboard product was also tested as part of this task, and was tested as part of Tasks 1, 4, 5 and 6. Also at each site, in-stream process samples were collected and analyzed for mercury concentration before and after each significant step in wallboard production. The Ontario Hydro results, process sample mercury concentration data, and process data were used to construct mercury mass balances across the wallboard plants.

The first FGD gypsum tested was from a power plant firing high-sulfur bituminous coal using a limestone forced oxidation (LSFO) wet FGD, no gypsum fines blowdown, and an active selective catalytic reduction (SCR) system. Ontario Hydro measurements revealed a total mercury loss across the wallboard plant of 5% of the incoming FGD gypsum mercury content, with only 1 to 2% of the mercury content evolved from any one process vent stack. Analysis also indicated that greater than 90% of the mercury detected during vent stack testing was elemental mercury. The second (bituminous coal, LSFO, and no SCR) and fourth (lignite coal, LSFO, and no SCR) test sets, representing plants that also did not employ fines blowdown, provided similar results.

The third FGD gypsum tested was from a power plant firing high-sulfur bituminous coal using LSFO FGD with gypsum fines blowdown and an active SCR. Ontario Hydro measurements detected 42% of the incoming mercury evolved/released in the mill portion of the wallboard plant, with 1% loss across the dry mill and 41% loss across the kettle calciner. Solids analysis indicated an additional 4% loss across the board dry kiln, for a total estimated mercury loss of 46%. While the percentage of mercury lost from the incoming synthetic gypsum is significantly higher than for the other configurations tested, the gypsum tested in the third configuration had relatively low concentrations of mercury. The amount of mercury released from the third configuration was not much greater than other configurations when expressed in terms of grams per hour. In addition, analysis of the third FGD gypsum indicated that approximately 99% of the mercury detected during wallboard vent stack testing was elemental mercury. The fifth test set (bituminous, LSFO, and no SCR) also employed fines blowdown and had similar results. Results for the sixth task are currently under review but should be available for discussion for the 2006 NETL Program Review presentation December 12, 2006.